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# THE RELATIONSHIP OF SELF-STIMULATION TO LEARNING IN AUTISTIC CHILDREN[1]

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The acquisition of discriminative behavior was studied in three autistic children with high-frequency self-stimulatory behavior. It was found that: (a) the children did not acquire the discrimination while engaged in self-stimulation; (b) suppression of self-stimulation produced an increase in correct responding, with eventual acquisition of the discrimination; (c) successful discrimination learning was always associated with a reduction in self-stimulatory behavior, even when aversive stimuli were not used for suppression.

Autistic children show considerable variability in their rate of acquiring new behaviors. While one child may acquire a given behavior in a day, another may require a year or more of intensive teaching to acquire the same behavior (Lovaas, Koegel, Simmons, and Stevens, *in press*). The literature has, however, generally failed to provide functional analyses of the conditions under which autistic children do and do not learn (Lovaas, Litrownik, and Mann, 1971).

Autistic children appear to be most unresponsive to their environment when engaged in ritualistic stereotyped behaviors. Because such behaviors do not produce any obvious social consequences for the child, they have been referred to as self-stimulatory behaviors or "self-stimulation" (Lovaas, 1967). Typical of such behaviors are rhythmic rocking, hand or arm flapping, and twirling objects in front of the eyes. Lovaas, *et al.,* (1971) demonstrated that autistic children who were trained to approach a dispenser for candy reinforcers at the sound of a tone, showed much longer response latencies when engaged in self-stimulatory behavior. It seems plausible, therefore, that such unresponsivity might interfere with the children's acquisition of new behaviors. Furthermore, Risley (1968) reported data showing that when self-stimulatory behaviors are punished, certain appropriate behaviors may show increases. This suggests the possibility that the elimination of self-stimulatory behavior may be a necessary prerequisite to the establishment of now appropriate behaviors.

This investigation, therefore, focused on a functional analysis of the relationship of self-stimulatory behavior to discrimination learning in autistic children. Three questions were asked. First, do autistic children fail to acquire discriminations when engaged in self-stimulatory behavior? Second, does suppression of self-stimulatory behavior facilitate the acquisition of a discrimination? Finally, will an autistic child who acquires a discrimination without external suppression of self-stimulatory behavior also show a reduction in self-stimulation during discrimination acquisition?

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## METHOD

### *Subjects*

Three autistic children participated. The first and third subjects were 7 yr old, the second, 5 yr old. All three were diagnosed as autistic by agencies not associated with this study; all subjects were mute and engaged in high-frequency self-stimulatory behavior. Because such behavior may take forms as difficult to detect as swishing saliva back and forth in the mouth, and as easy to observe as rocking vigorously back and forth in a chair, a further characteristic for the selection of these children was that they exhibited easily observable self-stimulatory behavior (see Procedure).

### *Apparatus*

Each child was seated in a 2.2 by 2.5 m experimental room in front of a 0.75-m high table holding a box with a 3-in. (7.6-cm) bar protruding from its front. The box also housed a Davis Model 310 Universal Feeder that delivered candy to subjects through a chute at the left side of the box. Sound equipment and one-way vision screens connected the experimental room to an observation room.

The children were taught to press the bar during a positive stimulus ($S^D$) interval, consisting of a 10-sec presentation of a visual and an auditory stimulus. The visual stimulus consisted of the onset of a 150-w red floodlight, mounted on the ceiling behind the subject's back and out of his view. It raised the room illumination level from 0.50 to 2.50 foot candles as measured on the front panel of the feeder by a Weston illumination meter, Model 756. The auditory stimulus, consisting of white noise, was fed from a tape recorder into a speaker located above the subject. The noise level generated was 63 dB (measured at subject's ear-level by a General Radio Co. Sound Level Meter, Type No. 1551B set at 20 kc weighting). Self-stimulatory behavior was recorded with a Rustrak multiple pen recorder. All aspects of the procedure, including the presentation of stimuli, operation of the feeder, and recording of bar presses, were carried out automatically with Davis Relay Programming Equipment.

### *Procedure*

Each subject was trained to respond (press the bar) during the $S^D$ interval (when the light and tone were presented), and to refrain from responding during the negative stimulus ($S^\Delta$) interval (when the light and tone were not presented). The $S^D$ interval remained in effect for 10 sec if the subject did not respond. If, however, the subject responded during the $S^D$ interval, the feeder delivered a candy reinforcer, and the $S^D$ interval terminated. Thus, the subject could receive a maximum of one food reinforcer during a given $S^D$ interval. The $S^\Delta$ intervals (no light or tone) were presented for from 5 to 15 sec (average interval: 10 sec). Termination of the $S^\Delta$ interval was only time contingent, and bar presses during the $S^\Delta$ interval were not reinforced. Thus, bar-pressing behavior was on extinction during the $S^\Delta$ intervals. A given trial consisted of the presentation of one $S^D$ interval, followed by the presentation of one $S^\Delta$ interval. A correct trial consisted of a lever press during the $S^D$ interval, and no lever press during the following $S^\Delta$ interval. For the first five trials of each session, the experimenter induced the subject to press the lever during $S^D$ intervals by placing the subject's hand on the lever. The experimenter would then sit in a chair behind the subject (out of his view) for the remainder of the 10-min session. Criterion for acquisition of the discrimination was at least 85% correct trials within a given block of 40 trials.

Self-stimulatory behavior was defined individually for each subject. The behaviors recorded for Subject 1 were rhythmic body rocking and the waving of hands or objects before his eyes; those for Subject 2 were gazing directly at the overhead houselight and rhythmic hand gripping; and for Subject 3, hair twirling, rhythmic finger manipulations, hand or arm flapping, repetitive vocalizations, and gazing at the houselight. When a subject engaged in any of these

behaviors, an observer depressed a button, activating the Rustrak recorder. The observer held the button down continuously until the self-stimulatory behavior ceased. Self-stimulation was recorded during 10 of the first baseline sessions for the first and second subjects, and in all sessions during each of the remaining conditions.

The reliability of self-stimulation recordings was assessed according to the following procedure. Two observers independently recorded self-stimulation during 13 random sessions throughout the various conditions: five reliability measures were taken for the first subject, five for the second subject, and three for the third subject. Each subject had a minimum of one reliability measure taken during each condition. One observer was familiar with the experiment and the other was naive. The per cent time subjects engaged in self-stimulatory behavior was computed for each 2.5-min interval of the 13 sessions, and a Pearson Product Moment Correlation Coefficient was obtained for the two observer's measurements in each session. All 13 correlations were above 0.93; that is, the data are reliable.

## EXPERIMENT 1

A baseline of per cent correct discrimination trials was individually obtained for each of the first two subjects during sessions when they were allowed to engage in self-stimulation to determine if there was any evidence of discrimination learning during that time. Self-stimulatory behavior was then suppressed after a different number of sessions for each child while discrimination training continued as before, in order to assess whether suppression of self-stimulatory behavior would facilitate acquisition of the discrimination. Self-stimulatory behavior was suppressed by the experimenter sharply saying "No!", and if necessary slapping the subject briskly on the hands when he began to engage in self-stimulatory behavior.

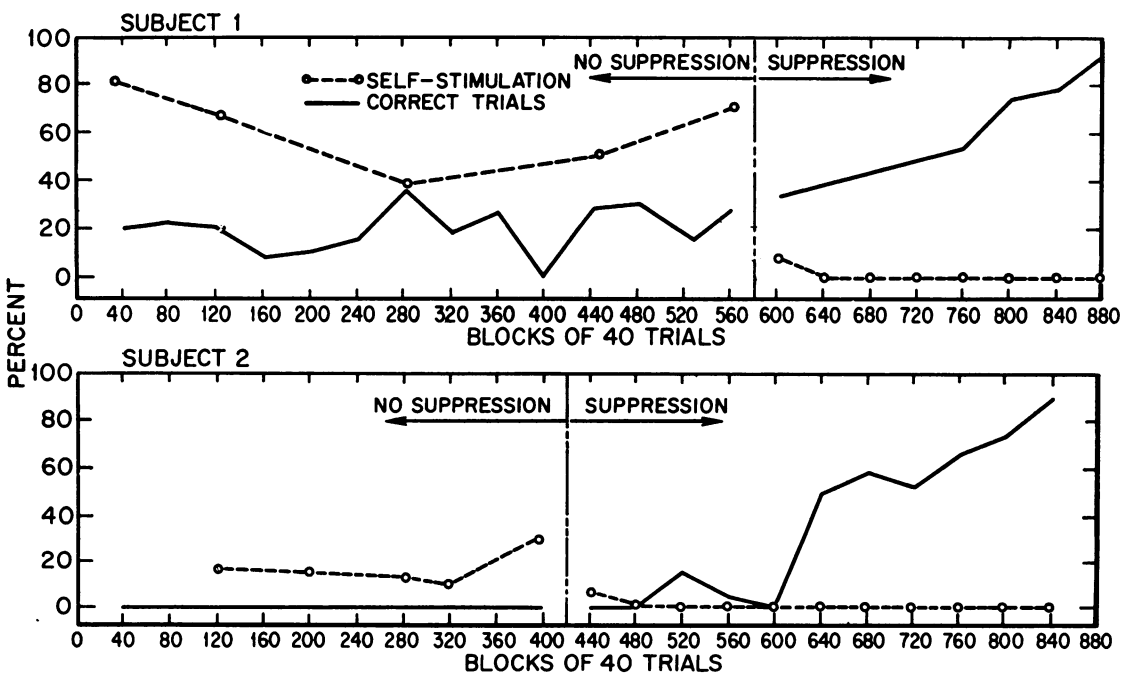


Fig. 1. Per cent occurrence of self stimulation and of correct trials are plotted on the ordinate for Subject 1 and Subject 2 when they engaged in self-stimulation (no-suppression condition); and when self-stimulation was suppressed (suppression condition).

## Results

Data for the first and second subjects, showing the baseline and first self-stimulation suppression sessions are presented in Figure 1. The ordinate shows per cent occurrence of self-stimulation and of correct trials. Blocks of 40 trials are presented on the abscissa. Subject 1 had 560 trials before suppression of self-stimulatory behavior, and Subject 2 had 400 trials before suppression. During the baseline (no suppression) condition, the per cent of correct trials for Subject 1 was consistently below 40% and that for Subject 2 was 0%. Both subjects made all possible combinations of errors. That is, on some trials they failed to respond during the $S^D$ interval; on other trials, they responded during the $S^\Delta$ interval; on still other trials they responded during both. There was no consistent pattern to either subject's errors. During these "no-suppression" sessions, the mean occurrence of self-stimulation for Subject 1 was 60% (range: 37% to 81%). The mean occurrence of self-stimulation for Subject 2 was 17% (range: 8% to 31%). There was no evidence of either subject acquiring the discrimination. However, after suppression of self-stimulation, both subjects began to increase their per cent of correct trials. After onset of the suppression condition, Subject 1 reached criterion for acquiring the discrimination in 320 trials, and Subject 2 in 440 trials.

This increase in the per cent of correct trials, reflects an increase in the number of correct responses, but not in the overall number of responses made by either subject. When self-stimulatory behavior was suppressed, there was no change in Subject 1's overall rate of bar pressing, and Subject 2 showed a slight decrease. This suggests that the failure of both subjects to acquire the discrimination during the non-suppression condition was not because self-stimulatory behavior was incompatible with bar-pressing behavior.

In summary then, Figure 1 shows that: (1) neither subject showed any evidence of acquiring the discrimination when he was engaged in self-stimulation; and (2) both subjects acquired the

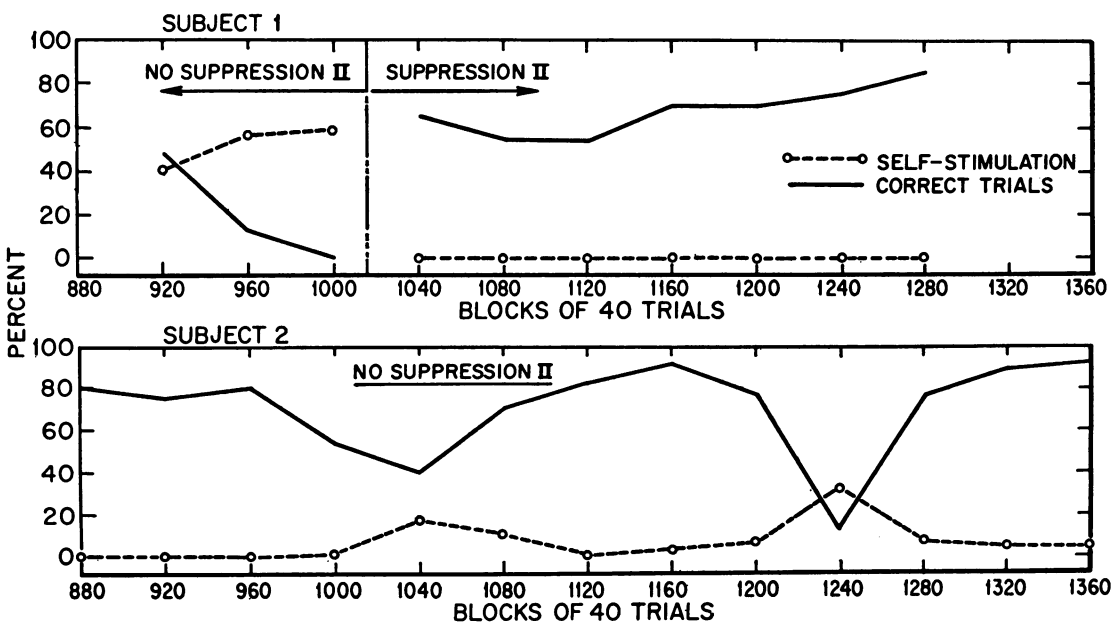


Fig. 2. Per cent occurrence of self-stimulation and of correct trials are plotted on the ordinate for Subject 1 and Subject 2 during the second "no-suppression" condition. Subject 1 had a second introduction of the self-stimulation "suppression" condition.

discrimination when self-stimulation was suppressed.

Figure 2 shows the results for Subject 1 and Subject 2 when suppression of self-stimulation was discontinued. Both per cent correct trials, and per cent occurrence of self-stimulation are plotted on the ordinate. As soon as suppression of self-stimulatory behavior was discontinued, Subject 1 again began to engage in self-stimulation, showing a concurrent decrease in his per cent of correct trials. Within 120 trials, Subject 1's per cent of correct trials fell to zero. Finally, a second introduction of the suppression condition again immediately increased the per cent of correct trials.

Subject 2 behaved somewhat differently. When the experimenter ceased to suppress self-stimulation, Subject 2 did not again immediately begin to engage in self-stimulation. With the exception of three blocks of 40 trials, Subject 2 kept his level of self-stimulation below 10%. Similar to Subject 1, Subject 2's per cent of correct trials showed an inverse relationship to his per cent of self-stimulation. When self-stimulation increased, per cent correct trials decreased. When self-stimulation decreased, per cent correct trials increased.

In summary, the results from Experiment 1 show that: (1) The subjects acquired the discrimination only when self-stimulatory behavior was suppressed; (2) suppression of self-stimulation produced an increase in correct responding with eventual acquisition of the discrimination for both subjects; and (3) performance on continued discrimination trials after criterion had been achieved, was inversely related to the subject's per cent of self-stimulation.

## EXPERIMENT 2

The data from the first two subjects might lead one to conclude that it is necessary to punish self-stimulatory behavior for an autistic child to acquire a discrimination. Yet, the inverse relationship of self-stimulatory behavior to the per cent of correct trials shown in Figure 2 suggests that punishment may not always be necessary. Although Subject 2 did not receive any punishment in the "no-suppression II" condition, low percentages of self-stimulatory behavior always accompanied high percentages of correct trials. These results prompted the question, if an autistic child acquires a discrimination without external suppression of self-stimulation, will he nevertheless show a reduction in his per cent of self-stimulation during discrimination training? The third subject was therefore selected because his therapists reported that they were able to teach him several discriminations when they used food reinforcers. We therefore reasoned that he might acquire the training discrimination in this study.

### METHOD

The third subject's per cent of self-stimulatory behavior was measured in an ABA design, where "A" refers to baseline sessions, and "B" refers to discrimination training sessions. During baseline sessions, the subject was seated in the experimental room with all equipment present, but no training trials were presented. During discrimination training sessions, $S^D$ and $S^\Delta$ intervals were presented in a procedure identical to that used in Experiment 1, including the five prompted trials at the beginning of each session. Each of the sessions in all conditions lasted 10 min.

### RESULTS

The results for Experiment 2 are shown in Figure 3. Percentages of both self-stimulation and correct trials are plotted on the ordinate for each of the sessions. During the first baseline condition (Sessions 1 to 8), the subject maintained a relatively high (50% to 90%) level of self-stimulation. Beginning with the ninth session, discrimination training trials were introduced. The subject immediately showed a large reduction in self-stimulation (to 18%) in the first training session, and continued to decrease his per cent of self-stimulation throughout this

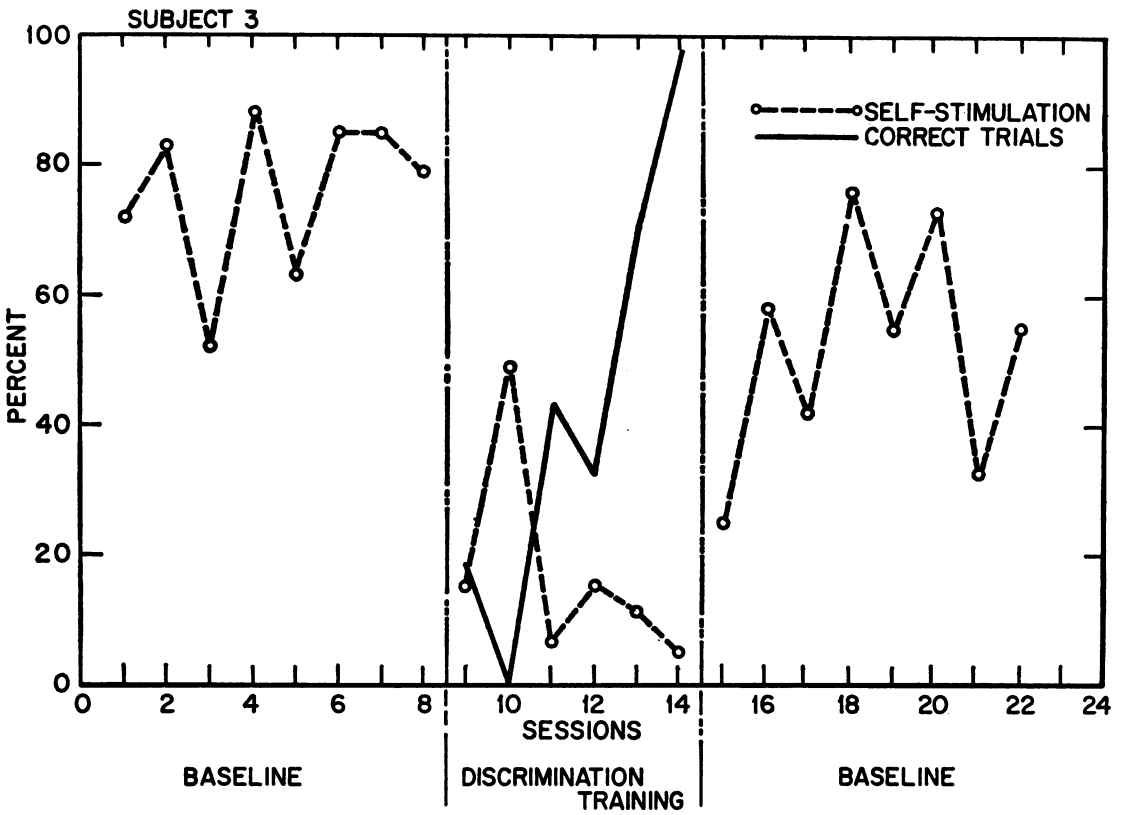


Fig. 3. Self-stimulation measures during baseline and discrimination acquisition conditions for Subject 3. Per cent occurrence of self-stimulation and of correct trials are plotted on the ordinate.

condition (to 4% by Session 14). The subject concurrently acquired the discrimination within 240 trials. The per cent of correct trials and per cent of self-stimulation again showed an inverse relationship. When self-stimulation increased, correct responding decreased; when self-stimulation decreased, correct responding increased. During the final nine sessions, a second baseline of self-stimulatory behavior was recorded. The level of self-stimulation immediately showed a large increase (to 24% in Session 15), and continued to remain at a level (32% to 75%) close to the original baseline measures.

In summary, the results for Experiment 2 show that introduction of successful discrimination training trials produced a large reduction in self-stimulatory behavior. Overall, the two experiments show that no subject acquired the discrimination without showing a concurrent decrease in self-stimulation.

## DISCUSSION

Three autistic children, who evidenced high percentages of self-stimulatory behavior were trained to respond during the presentation of an auditory and visual stimulus and not to respond during the absence of these stimuli. The results showed that: (a) the children did not acquire the discrimination while they engaged in self-stimulation; (b) suppression of self-stimulation produced an increase in correct responding, with eventual acquisition of the discrimination; and, (c) successful discrimination learning was always associated with a reduction in self-stimulatory behavior, even without the use of aversive stimuli for suppression.

There is one obvious qualification concerning the choice of subjects that should be imposed upon these data; all three subjects were among the most regressed group of autistic children,

with no language skills and a high frequency of self-stimulation. It is possible that different results might have been obtained with children who were either more advanced or less involved in self-stimulation.

*The Relationship of Self-stimulation to Learning*

There are several ways in which the results can be interpreted. First, they can be interpreted on the basis of competing reinforcers. Lovaas, *et al.,* (1971) suggested that self-stimulation may be such a powerful reinforcer, that when given a choice between self-stimulation and working for food, autistic children choose self-stimulation. However, when such children are unusually hungry, or when food has otherwise increased its power as a reinforcer, the children may perform the response required to obtain food. This would account for the almost perfect inverse relationship between per cent self-stimulatory behavior and per cent correct trials on the discrimination, except for one point. That is, in this study it was entirely possible for the child to continue engaging in self-stimulation while at the same time pressing the lever. (Thus, the subject could have, so to speak, had his cake and eaten it too.)

A second interpretation of the data is suggested by two previous studies (Lovaas, Schreibman, Koegel, and Rehm (1971); Lovaas and Schreibman (1971)) that demonstrated that when autistic children received several simultaneously presented relevant stimuli, only one acquired control over the children's behavior. That is, the children appeared selectively to attend to only one of the stimuli. Similarly, in the present study, the autistic children may have been selectively attending to their self-stimulation, and thus failed to acquire the discrimination. The almost perfect inverse relationship between the occurrence of self-stimulation and correct responding lends strength to this argument.

Functionally, the data suggest that if one attempts to teach a new behavior to an autistic child, it is important to ensure that the child does not engage in self-stimulatory behavior. Some children may cease to engage in self-stimulatory behavior without external suppression. In this case, one might expect acquisition of the behavior to occur. However, other children will not cease to engage in self-stimulatory behavior during training. In this case, acquisition of the new behavior will probably not take place unless the self-stimulatory behavior is externally suppressed.

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